national accelerator laboratory

EXP-25 (revised)

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ACCELERATOR EXPERIMENT--Missing Bunches and Sextupoles in the Booster

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1. Six air-core sextupoles have been placed in the Booster in the following locations: two in the long straight section No. 3, two in the long straight section No. 11, and two in the long straight section No. 19.

ℓ = length of one sextupole = 0.6 m

g = strength of one sextupole = $\pm$ 15 kG/m^2

$\beta_x \sim$ 7.0 m

$\beta_y \sim$ 20.0 m

$X_p \sim$ 1.8 m

Bρ = magnetic rigidity around the transition $\sim$ 160 kG · m

ν_x = 6.7

ν_y = 6.8

The full strength of a sextupole is achieved with a current of about 40 A.

2. If we define the "chromaticity" as the variation of ν with the momentum p, namely

$$\xi = \frac{\Delta\nu/\nu}{\Delta p/p} = 6 \cdot \frac{\ell \beta X_p g}{2\pi\nu\,(B\rho)}$$

we have, around the transition and with full strength,

$\xi_x = \pm$ 0.10 $\qquad\qquad$ $\xi_y = \pm$ 0.30

3. With a beam of a typical intensity of 10 - 18 mA we made the following experimental observations:

a) Sextupole current: + 40 A. The beam was stable, also around the transition. No intensity drops, characteristic of the "missing bunches" effect, were detected for whatever current of the beam.

b) Sextupole current: + 25A. No change. The beam was still stable.

c) Sextupole current: + 15 A. The beam now was unstable. Intensity drops were detected for beams of more than 15 mA. Pulses with an intensity less or equal to 15 mA were noticed still stable.

d) Sextupole current: zero. Not much change from the previous observation, only that now the drops in intensity were very large. The beam still seemed stable for intensities less than 15 mA.

e) Sextupole current: - 15 A. The beam became more unstable. Also, the pulses with an intensity as low as 13 mA appeared unstable.

f) Sextupole current: - 40 A. Maximum of instability. The intensity was reduced down to about 9 - 10 mA. The instability seemed to occur much earlier in the cycle.

All of these observations are the results of fairly long beam watching, and they represent the average of what we saw. Fluctuations of the beam behavior from the standard way have been noticed, especially for intermedium values of the sextupole current. It seemed to us that (1) the sextupole component of the machine changes over long periods of time, and (2) the injection conditions also fluctuated from pulse to pulse.

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